Run II Upgrades Status
June 2005 Report

Pushpa Bhat
Outline

• Technical Progress
• Status Report for June '05
  ➢ Milestones
  ➢ % Complete
  ➢ M&S Costs
  ➢ Effort Report
• Contingency Analysis
Electron Cooling of Antiprotons

• Electron cooling of antiprotons demonstrated
  - Central part of the Run II upgrades, needed to achieve design luminosity beyond Phase-2

• Milestone achieved about two months ahead of schedule on July 9, ’05
  - Anticipated milestone date: Sep. 8, ’05
e-cool Demo

• Interaction of electron beam (200 mA dc) and 1E10 antiproton beam and first hints of antiproton cooling seen in the Recycler, evening of Saturday, July 9th

• Reconfirmed on Monday, July 11th with 35-40E10 pbar beam in the Recycler

• Longitudinal emittance goes from 18 eV-s → 8eV-s, well below what is achieved with stochastic cooling
- Seen reduction in trans. Emittance as well
- e-cooled pbars already used in 3 Tev stores
  - 98% efficiency for mining

- Blue trace - beam before electron cooling
- Pink trace - beam after electron cooling for 15 minutes
e-cool

- The observation is a significant achievement by itself
- But, lots to do to integrate into operations as required by the upgrade plan
  - Design scenario assumes 600E10 pbars stored and cooled in the Recycler for Tev shots
  - High current operations (500 mA of e beam)
  - Optimize beam properties, alignment
  - Issues of instabilities at higher pbar intensity
  - ...
  - ...
Instrumentation

Tevatron BPM Project
• Installation and Commissioning ~100% complete and Tev BPM system operational
• Project officially closed
• Remaining tasks to be reported to Tev Department accounts

IPMs, OTRs
➢ Detectors assembled
➢ Will be ready for installation this shutdown

BPMs in pbar source, transferline BPMs
➢ Good progress

BLMs
➢ Testing prototype (digitizer and timer cards) at MI60; ACNET readout to be available this week. Monitor up to 4 channels.
➢ Integration testing in 2-3 weeks
MI BPM Project

- Main Injector BPM Technical review (M. Martens)
  - Monday July 25th, 1-5 pm

- Committee members:
  - Jim Steimel
  - Craig Moore
  - Al Baumbaugh
  - Patty McBride
  - Jim Patrick

- Charge
  - Review the updated specs and the overall project plan including schedule and resources

- Project management: Wolbers (CD), Webber (AD), Banerjee (CD)
  - Use the experience & expertise from Tev BPM project
Tevatron Helix/Separators

- **Tevatron Electrostatic Separators**
  - Conditioning tests of separator with electropolished SS electrodes complete.
    - Best spark rate and dark current so far up to 178 kV in the teststand.
  - High voltage conditioning of 5 spares continues. All should be ready in time for the shutdown.
    - 1 horz at A17, 1 vert at B48; swap out 3 separators at A49 (limits helix size at HEP due to sparking).
  - Still experiencing difficulty commissioning spare power supplies.
  - Damaged a 1 mega-ohm shunt resistor and HV cable (in teststand) during high voltage conditioning.
Upgrades Shutdown Activities

• pbar studies (stacktail upgrade-related)
  ➢ High intensity proton stacking & upgrade prototype tests
    • Learn about the current system, tank move & upgrade design
    • Prefer first 2 weeks (10 days min.) of the shutdown in the Fall
    • If not, a study period in the Fall → interruption to the collider run for ~ 10 days
    • Depends on improvements we make in the near future← RRT

• Pbar installations
  ➢ Band-4 cooling tanks
  ➢ DB Extraction kicker magnet

• Tevatron Installations
  ➢ Separators → 2 new; 3 swap
  ➢ IPM
  ➢ OTR
  ➢ TEL-2

• Tevatron Alignment
Status Report
### Milestones (April – September ’05)

<table>
<thead>
<tr>
<th>WBS</th>
<th>Name</th>
<th>MS Class</th>
<th>Finish</th>
<th>Base Fin</th>
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<tr>
<td>1.4.5.4.3.2.3.2</td>
<td>Offline SW code complete</td>
<td>C</td>
<td>5/17/05</td>
<td>12/23/04</td>
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<td>1.1.3.3.5</td>
<td>MI 2.5 MHz Acceleration complete</td>
<td>B</td>
<td>7/20/05</td>
<td>1/31/05</td>
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<td>1.4.5.4.4.1.7</td>
<td>All Tev BPM crates functionally available (except for F bldg.) or Installed</td>
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<td>5/13/05</td>
<td>2/10/05</td>
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<td>1.4.5.4.4.2.2</td>
<td>TEV BPM Frontend Integration Test Complete</td>
<td>C</td>
<td>5/31/05</td>
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<td>1.1.1.2.2.6</td>
<td>MLRF upgrade complete</td>
<td>C</td>
<td>4/27/05</td>
<td>3/31/05</td>
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<tr>
<td>1.1.1.2.3</td>
<td>MLRF RF Upgrades &amp; Improvements Complete</td>
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<td>4/27/05</td>
<td>3/31/05</td>
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<tr>
<td>1.4.5.4.6.8</td>
<td>Tev BPM Upgrade Operational</td>
<td>B</td>
<td>6/30/05</td>
<td>3/31/05</td>
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<td>1.3.5.6.1.1.5</td>
<td>Ubend Commissioned (Milestone)</td>
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<td>4/14/05</td>
<td>4/1/05</td>
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<tr>
<td>1.3.5.6.3.1</td>
<td>Full Beamline Commissioned</td>
<td>C</td>
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<td>1.3.5.6.3.5</td>
<td>Obtain 500 MA DC Beam (Milestone)</td>
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<td>Review Tevatron Alignment Plans 2005 (Milestone)</td>
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<td>10/5/05</td>
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- ◇ Baseline Finish Date
- ♦ Actual Finish Date
- ○ Forecast Date
## Progress as of June 30, 2005

### % Complete

<table>
<thead>
<tr>
<th>WBS</th>
<th>Name</th>
<th>Actual %</th>
<th>Planned %</th>
<th>A/P %</th>
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<td>75%</td>
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<td>Luminosity Upgrades</td>
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<td>Protons on Pbar Target</td>
<td>61%</td>
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<td>Pbar Acceptance</td>
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<td>64%</td>
<td>85%</td>
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<td>1.3</td>
<td>Pbar Stacking &amp; Cooling</td>
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<td>88%</td>
<td>89%</td>
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<tr>
<td>1.4</td>
<td>Tevatron High Luminosity</td>
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<td>79%</td>
<td>95%</td>
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<td>Shutdowns</td>
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<td>50%</td>
<td>100%</td>
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<td>Project Management</td>
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<td>69%</td>
<td>100%</td>
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<td>2</td>
<td>Maintenance &amp; Reliability</td>
<td>62%</td>
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<td>100%</td>
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## M&S Spending through June '05

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<tr>
<th>M&amp;S Spending through June 2005</th>
<th>Planned (April 05)</th>
<th>FY05</th>
<th>Inception (FY04) To date Costs</th>
<th>% FY05 Budget Used</th>
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<td>RLS Estimate (then yr)</td>
<td>FY05 Total</td>
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<td>Actual Obligations Obl+RIP</td>
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### Breakdown

- **Run II Upgrades**
  - **Total** 14
  - **ITD Obl+RIP** 14
  - **YTD Obl+RIP** 14

### 1. Luminosity Upgrades
- FY05: 5,196
- Total: 17,791
- Inception: 13,596
- % FY05 Budget Used: 76%
- YTD Obl+RIP: 13,536
- % YTD Obl+RIP: 53%

### 1.1 Protons on Target
- FY05: 1,607
- Total: 6,536
- Inception: 3,536
- % FY05 Budget Used: 74%
- YTD Obl+RIP: 1,819
- % YTD Obl+RIP: 25%

#### 1.1.1 Slip Stacking
- FY05: 417
- Total: 10
- Inception: 0
- % FY05 Budget Used: 96%
- YTD Obl+RIP: 12
- % YTD Obl+RIP: 272%

#### 1.1.2 Pbar Target and Sweeping
- FY05: 54
- Total: 0
- Inception: -3
- % FY05 Budget Used: 22%
- YTD Obl+RIP: 12
- % YTD Obl+RIP: 12

#### 1.1.3 MI Upgrades
- FY05: 963
- Total: 550
- Inception: 516
- % FY05 Budget Used: 54%
- YTD Obl+RIP: 516
- % YTD Obl+RIP: 520

#### 1.1.4 Booster-MI Cogging
- FY05: 0
- Total: 0
- Inception: 0
- % FY05 Budget Used: 0%
- YTD Obl+RIP: 0
- % YTD Obl+RIP: 0

#### 1.1.5 OTR
- FY05: 174
- Total: 69
- Inception: 254
- % FY05 Budget Used: 47%
- YTD Obl+RIP: 254
- % YTD Obl+RIP: 145%

### 1.2 pbar Acceptance
- FY05: 1,444
- Total: 343
- Inception: 766
- % FY05 Budget Used: 55%
- YTD Obl+RIP: 766
- % YTD Obl+RIP: 100%

#### 1.2.1 LiLens
- FY05: 517
- Total: 102
- Inception: 276
- % FY05 Budget Used: 52%
- YTD Obl+RIP: 276
- % YTD Obl+RIP: 144%

#### 1.2.2 AP2 and DB Acceptance
- FY05: 928
- Total: 240
- Inception: 490
- % FY05 Budget Used: 56%
- YTD Obl+RIP: 490
- % YTD Obl+RIP: 81%

### 1.3 pbar Stacking and Cooling
- FY05: 5,072
- Total: 1,173
- Inception: 4,035
- % FY05 Budget Used: 78%
- YTD Obl+RIP: 4,035
- % YTD Obl+RIP: 75%

#### 1.3.1 S&C Task Force
- FY05: 0
- Total: 0
- Inception: 0
- % FY05 Budget Used: 0%
- YTD Obl+RIP: 0
- % YTD Obl+RIP: 0

#### 1.3.2 Debuñcher Cooling
- FY05: 0
- Total: 0
- Inception: 0
- % FY05 Budget Used: 0%
- YTD Obl+RIP: 0
- % YTD Obl+RIP: 0

#### 1.3.3 Stacktail Upgrade
- FY05: 1,507
- Total: 105
- Inception: 795
- % FY05 Budget Used: 56%
- YTD Obl+RIP: 795
- % YTD Obl+RIP: 144%

#### 1.3.4 Recycler Commissioning
- FY05: 469
- Total: 228
- Inception: 258
- % FY05 Budget Used: 60%
- YTD Obl+RIP: 258
- % YTD Obl+RIP: 33%

#### 1.3.5 Electron Cooling
- FY05: 2,536
- Total: 522
- Inception: 2,561
- % FY05 Budget Used: 95%
- YTD Obl+RIP: 2,561
- % YTD Obl+RIP: 102%

#### 1.3.6 Rapid Transfers
- FY05: 560
- Total: 318
- Inception: 422
- % FY05 Budget Used: 77%
- YTD Obl+RIP: 422
- % YTD Obl+RIP: 37%

### 1.4 Tevatron High Luminosity
- FY05: 5,207
- Total: 1,205
- Inception: 4,278
- % FY05 Budget Used: 82%
- YTD Obl+RIP: 4,278
- % YTD Obl+RIP: 54%

#### 1.4.1 Beam Studies and Simulation
- FY05: 380
- Total: 0
- Inception: 41
- % FY05 Budget Used: 106%
- YTD Obl+RIP: 41
- % YTD Obl+RIP: 41

#### 1.4.2 Active BBC
- FY05: 1,414
- Total: 360
- Inception: 649
- % FY05 Budget Used: 50%
- YTD Obl+RIP: 649
- % YTD Obl+RIP: 62%

#### 1.4.3 Increased Helix Separation
- FY05: 1,039
- Total: 221
- Inception: 924
- % FY05 Budget Used: 90%
- YTD Obl+RIP: 924
- % YTD Obl+RIP: 934

#### 1.4.4 Luminosity Leveling
- FY05: 0
- Total: 0
- Inception: 0
- % FY05 Budget Used: 0%
- YTD Obl+RIP: 0
- % YTD Obl+RIP: 0

#### 1.4.5 Improved Controls and Diagnostics
- FY05: 2,174
- Total: 358
- Inception: 2,167
- % FY05 Budget Used: 99%
- YTD Obl+RIP: 2,167
- % YTD Obl+RIP: 66%

#### 1.4.6 Tevatron Vacuum Improvements
- FY05: 235
- Total: 80
- Inception: 197
- % FY05 Budget Used: 84%
- YTD Obl+RIP: 197
- % YTD Obl+RIP: 5%

#### 1.4.7 Tevatron Alignment
- FY05: 307
- Total: 186
- Inception: 300
- % FY05 Budget Used: 86%
- YTD Obl+RIP: 300
- % YTD Obl+RIP: 28%

### 1.6 Management
- FY05: 198
- Total: 1,063
- Inception: 154
- % FY05 Budget Used: 5%
- YTD Obl+RIP: 154
- % YTD Obl+RIP: 5%

### 2 Reliability Upgrades
- FY05: 4,262
- Total: 2,124
- Inception: 2,221
- % FY05 Budget Used: 75%
- YTD Obl+RIP: 2,221
- % YTD Obl+RIP: 64%

#### 2.1 Vulnerability White Paper
- FY05: 2,599
- Total: 1,306
- Inception: 1,065
- % FY05 Budget Used: 77%
- YTD Obl+RIP: 1,065
- % YTD Obl+RIP: 89%

#### 2.2 Reliability Upgrades
- FY05: 1,663
- Total: 818
- Inception: 1,157
- % FY05 Budget Used: 73%
- YTD Obl+RIP: 1,157
- % YTD Obl+RIP: 23%
## Effort for June 2005

<table>
<thead>
<tr>
<th>Adjusted FTE June 2005</th>
<th>Totals</th>
<th>Plan 3 MO rolling ave.</th>
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<tr>
<td><strong>Run II Upgrades</strong></td>
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<td>Luminosity Upgrades</td>
<td>77.5</td>
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<td>1.1  Protons on Target</td>
<td>5.7</td>
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<td>1.2  pbar Acceptance</td>
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<td>1.3  pbar Stacking and Cooling</td>
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<td>2  Reliability Upgrades</td>
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<td>10.8</td>
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## Contingency Analysis

- **Estimate to complete:** $18,104 - $13,596K = $4,508K
- **Contingency remaining:** $20,946K - $18,104K = $2,842K

### Contingency Need estimate vs. Obl. To complete

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate</th>
<th>Obl. To complete</th>
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<tbody>
<tr>
<td>MI BPM</td>
<td>$200K</td>
<td>$460K</td>
</tr>
<tr>
<td>Rapid Transfers</td>
<td>$100K</td>
<td>$160K</td>
</tr>
<tr>
<td>Recycler</td>
<td>$200K</td>
<td>$200K</td>
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<tr>
<td>E-cool</td>
<td>$200K</td>
<td>$150K</td>
</tr>
<tr>
<td>Stacktail</td>
<td>$300K</td>
<td>$700K</td>
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<tr>
<td>Other</td>
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**Major Concerns/New scope?**
- Pbar Stack rate related: $300K
- Booster HLRF (SS + NUMI): $300K → $1.8 M

> **Serious Vulnerability** → Linac 7835 tubes

- Linac Task Force recommendation → explore Thales tubes
- Collaborate with Los Alamos; Test station ~ $2 M